Closeout Report

on the

Director's Status Review

of

BTeV

October 2, 2002

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of
BTeV

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Executive Summary

Summary of the Technical Status of BTeV

The BTeV experiment is a single-arm forward spectrometer in the Tevatron proton-antiproton collider. It emphasizes charged particle tracking and triggering using silicon pixels, silicon microstrip detctors and straw tubes, as well as emphasizing neutral particle reconstruction using a fine-grained lead tungstate (PWO) detector. Particle identification is acheived using a Ring Imaging Cerenkov (RICH) detector for protons, kaons and pions, and a toroidal spectrometer for muons. The detector triggers on events containing muons from B decays or events with a secondary vertex from B decays.

The pixel system has solved a major difficulty with such systems by operating the pixels themselves inside a vacuum vessel, and using electrical feed-throughs that do not physically penetrate the vacuum wall. A critical remainng area of R&D is a detailed plan of how to cool the pixels.

The tracking planes use a mixed technology: silicon strip detectors at small radii and straw tubes at larger radii. The combined tracking resolution is expected to be better than 1% for all momenta of interest within the spectrometer acceptance. The detailed plan for mounting the silicon and straws in planes is still under development.

Since the last review, the RICH technology has changed. Originally, the system was envisioned to have a gas and an aerogel radiator with the light mirror-focused onto a hybrid-photdiode array. The present design replaces the aerogel with a liquid radiator, proximity-focused onto an array of photomultiplier tubes. This design rectifies a problem with the original design: there was very little light from the aerogel and it was difficult to resolve these rings in the presence of the much brighter rings from the gas. The new design is somewhat thicker (~9% of a radiation length), but since the RICH is located downstream of the magnet, the impact of this change on the electromagnetic calorimeter is managable.

The EM calorimeter is an array of ~10,000 PWO blocks. These blocks have been tested in a beam at Protvino and show a resolution of 1.8%/sqrt(E) and a constant term of 0.33% and indicate that it is likely that these crystals will survive the BTeV environment for at least a decade. BTeV has developed a plan for mounting these crystals at a cost 70% less than the equivalent CMS structure. This plan will also allow individual crystals to be installed into the array during short accesses to C0.

BTeV's muon detector system is constructed from ~36,000 stainless steel proportional tubes mounted in three planes separated by two 1m thick magnetized iron toroids. The detector design (both mechanical and electronic) is traditional and quite well-advanced. The remaining issues involve how to successfuly mount this detector in the constrained space in the BTeV toroid region.

The trigger and data aquisition (DAQ) systems have as a goal to reject 99.95% of the background events and to recoed at least half of all B events to tape. The primary trigger involves idetifying bottom hadrons by their long lifetimes, and a secondary trigger identifies them via their semimuonic decays. The trigger hardware revolves around two farms of processors: digital signal processors and field programmable gate arrays at Level 1, and commodity CPUs at the higer levels. Present-day CPU's are not adequate to the task, but extrapolation from Moore's Law indicates that they will be available before BTeV needs to purchase them. A previous review was concerned about the fault-tolerance of this design, and to address this an NSF-funded Real Time Embedded Systems (RTES) research group was formed. The DAQ originally used a custom high speed data network to collect and assemble the event data. This design has been replaced by 8 commercial systems in parallel, at considerable reduction of technical risk.

Cost, Schedule, and Management Status

The BTeV team has done an admirable job of developing a good basis for the estimate at this early stage of the project. The estimate is based on the preparation of requirements and specifications; significant R&D results; some preliminary system design; and in several cases quotes for large cost items. However, a significant contributor to cost uncertainty is the lack of an integrated resource loaded schedule. Currently, each Level 2 project is allowed to develop their schedule without funding constraints.

The committee recommends increasing the BTeV estimate from $104M to $122M, with $10M of the increase to cover G&A. To convert to "as spent" dollars, this must be increased by about 12%.

It is anticipated that the project will begin October 1, 2004. Furthermore it is anticipated that project completion will be early in fiscal year 2008. A critical interim milestone is "readiness to install large components," currently planned for April 2006. BTeV is in the process of uploading their "EXCEL" project schedules into Open Plan. No easily understood resource loaded schedule exists. However, this situation will be rectified with the completion of the Open Plan uploads and optimization process.

BTeV management is appropriate for this stage of the project. The management and the BTeV team has the challenge of meeting a rather "high bar" to pass CD-0, namely undergo a P5 or equivalent review. Immediately following CD-0 approval BTeV will need expand and formalize the management structure and systems.

1.1 Vertex, Toroidal Magnet, Beam pipes

Findings

- The WBS as presented totaled 1.4M$ base cost, with an estimated contingency of 38% for a total estimate of 1.9M$.

- The WBS as presented includes assembly and measurement of the vertex magnet in the C0 hall; assembly and measurement of the muon toroid system in the C0 Hall; and procurement and delivery to the C0 hall of various beam pipe components. Many of the major components are reassembled from previous experiments: the vertex magnet is the re-assembled SM3 magnet. the toroid uses reworked SM12 steel; the compensation dipoles are 10' B2 magnets, and some of the beam pipe reuses the CDF I Be beam tube.

- Within the past 3 years, BteV has done a partial disassembly of a portion of the SM3 steel, and has made a concrete mockup of the forward tracking region. There is considerable experience in the collaboration using the magnets.

- The WBS as presented includes 403k$ base cost of "R&D". It was not clear if this was part of the FY04-08 construction project or R&D before the construction project in FY03.

- There is a WBS roll-up, backed by a WBS dictionary. The cross referencing of the line numbers in the two documents needs to be reviewed. Drill down through a couple of the larger items showed them to be based on recent BTeV experience, and / or recent discussions with vendors; the WBS appears to be reasonably defendable for this stage of the project. Some items were identified as missing, such as interim beam tubes, a spare B2 dipole, and refurbishment of the B2 magnets.

- There is not an integrated, resource loaded schedule for this WBS.

- Some components of the proposed C0 AIP are needed, particularly for measurement of the magnets. The timescale and potential interferences with the AIP project are not known.

- The impact of the magnets (including compensating dipoles) and their fringe fields on Tevatron operation is believed to be small, but has not been verified by BD / AP.

- The potential impact of the new components on the beam vacuum is believed small, but has not been formally verified with the BD / Vacuum group.

Comments

- In many ways, the building blocks for this task appear available and reasonable. They need to be assembled in a manner consistent with the rest of the project.

- Cross referencing of the WBS, use of consistent numbers in the WBS and in the presentations, and breakout presentations would be very helpful in making the system more transparent to the next reviewers.

Recommendations

1. An integrated, resource loaded schedule must be completed for this task.

2. The WBS dictionary and roll-up should be scrubbed and made consistent.

3. A TDR should be completed

4. The R&D program should be determined to be on / off the construction project.

5. Formal verification / agreements with the BD AP and Vacuum groups need to be completed.

1.2 Pixel Detector

Findings

- This is an ambitious project requiring important R&D on several aspects. The members of the pixel group have identified the essential tasks and made progress both on baseline and on backup technologies. Many aspects of the project have already received considerable attention, from prototyping to installation plans. The group plans to use the remaining year of R&D to attack the outstanding unsolved problems associated with baseline technologies, with the understanding that as that period concludes, the timeline for decisions between those baselines and their backups will be finalized.

Comments

- A detailed method for estimating contingencies was used but not presented explicitly in the documents.

- A number of important R&D activities are significantly advanced but not presented in full detail in the documents.

- Plans for a database that tracks component testing and assembly are still at a very early stage.

- Pixel mechanical support still needs substantial R&D, especially to ensure that the water-glycol connections in the system are reliably leak-free.

- This project needs to receive its funding early in the contruction period.

Recommendations

1. Expand BTeV document 853 (Production, Production Testing, and Quality Assurance Plan).

2. Expand BTeV document 1051 (Completed and Planned R&D).

3. Document more fully the method ("SDC methodology") used for estimating contingencies. Use this method to expand BTeV document 1145 (Risk Assessment).

4. Review those aspects of the schedule that reflect iterations (for example, sensor prototyping, pre-production, and production) to determine what degree of repetition of activities (for example, mask design) is realistically likely while preserving an appropriately conservative scenario.

5. Clarify the organization of collaborative activities such as teststand implementation and operation.

6. Annotate tasks in the construction schedule that are accelerated because of their connection with R&D activities which may not appear in that schedule directly.

7. Investigate the possibility of sensor breakdown due to fast beam losses. Examine beam loss scenarios with the Beams Division and consider tests to understand if the sensor-chip assembly will be damaged by associated voltage spikes.

8. Work with the Beams Division to understand whether the design of the pixel vacuum system and RF shield provides an acceptable vacuum environment and beam impedance.

1.3 RICH Detector

Findings

- Substantial progress has been made in defining the technical aspects of this sub-project. Two choices exist for the photo-detection devices from photons generated in the main radiator, namely hybrid photo-diodes (HPDs) or multi-anode photo-multiplier tubes (MAPMTs). This single element represents approximately 50% of the cost of the entire sub-project. The HPDs have been thoroughly investigated and only one technical question remains to be resolved – what level of residual magnetic field can be tolerated before a software 're-map' is necessary and this will be determined in the next month or so. The second option, MAPMTs, has only recently become a possible choice due to a favorable cost reduction. This choice will need thorough investigation (on the time scale of a year) before a baseline choice can be determined. Operational experience gained in a test beam setup will be weighed along with cost in the final decision. Based on previous pricing for the MAPMTs, a 31% contingency was assigned. This should be increased since these items are acquired from other countries.

- Most other 'big-ticket' items are backed up with vendor quotations in the cost book. This includes 5000 PMTs (3-4 possible vendors), readout electronics, mirror arrays and power supplies. Other bases for estimate are tied to previous experience from the proponents with the CLEO III RICH, a proximity focused detector.

- During discussion, several items became clear:

  1) The cost book was found to have several errors which need to be corrected:
     For example:
     a) Section 1.3.4 - Mirror array testing and mirror mounts were scrambled together.
     b) Vendor quotes for power supply infrastructure are missing.

  2) A detailed schedule for component installation in C0 needs to be developed – the feasibility/rewards of partial detector installation with subsequent testing needs to be evaluated.

  3) Adequate monitoring/suppression of He in the collision hall (which will have an impact on phototube lifetimes) needs to be addressed.

Comments

- One area of concern is the mirror array for which the requirements specification yet needs to be made. The assumption to date is that mirrors similar to those for HERA-B would be adequate, but the BTeV RICH has the mirror system pointed substantially more off-axis than the HERA-B RICH and thus the mirror quality needed is expected to be necessarily enhanced. This needs to be simulated and specifications for deviations in an individual mirror average radius of curvature and the variations in curvature over an individual mirror should be specified. Also missing as well are alignment tolerances on mirror position and direction during installation and a plan for certifying mirror alignment in situ in C0 needs to be developed.

- Many names appear in multiple places in the manpower assessment. While RICH detectors no longer are the manpower sinks of the past given the current trend away from gaseous based and toward PMT-style based photon detectors, this is a big project. The addition of other manpower, for example to take on the mirror system, should be encouraged.

<u>Recomendations</u>

1. Develop requirements for the mirror system, including the deviation of the average mirror radius, the deviation in radius across an individual mirror and alignment tolerances.

2. Develop an installation sequence plan, including consideration of partial installation and testing options.

3. Correct errors in the cost book.

1.4 EM Calorimeter

WBS 1.4 covers the PWO crystal electromagnetic calorimeter (ECAL) subsystem. The total base cost is estimated to be 10.7 M$, including 8.5 M$ of material and 2.2 M$ of labor. The overall total cost is 14.2 M$ with 32% contingency.

With solid quotations from respected vendors, the reviewer modified the base cost of PWO crystals and PMT correspondingly and reduced the contingency from 40% to 30%. Lacking detailed design, the reviewer increased the contingency for LED monitoring system from 30% to 40%. The reviewer's estimation is 14.5 M$ overall total cost with 11.3 M$ base and 28.4% contingency.

Findings

- The ECAL team did extensive study on PWO crystals by using test beam facility at Protvino. The result shows excellent energy and position resolutions promised by total absorption crystal calorimetry, which will put the BTeV experiment in cutting edge as compared to the LHCb experiment.

- PWO crystal samples provided by four vendors were systematically tested at Protvino. The result indicates that PWO crystals from BTCP, Russia, and SIC, China, can be used in the BTeV radiation environment without significant degradation of performance. The radiation damage suffered by PWO crystals can be followed, and corrected for, by an LED based light monitoring system.

- The proposed QIE front-end readout presents no significant technical/cost risk. Although not yet finally designed, the development of the QIE ASIC is expected to be smooth. The team designing ECAL readout electronics has sufficient expertise and experience.

- The ECAL team has abandoned conventional carbon fiber honeycomb mechanical structure. Taking advantage of the space available for strong support, a thin aluminum sheets based support structure is adapted and prototyped. Its cost is less than 30% of the scaled down cost of the CMS ECAL endcap mechanics.

- While the overall cost estimation is bottom up based upon quotations from vendors and experiences from CLEO and similar projects at FNAL, there are missing items, such as crystal wrapping or coating and uniformization. Without detailed design, the LED based monitoring system does not have bottom up cost estimation.

- The overall contingency was assigned according to the maturity of the design and risk assessment, which seems reasonable at this stage of the project.

Comments

- The ECAL heat dissipation was estimated assuming normal operation of the PMT without taking into account possible increase of the dark current caused by neutron activation and radiation induced phosphorescence. The estimation of the heat dissipation of the entire system (20 W) may be underestimated.

- It is known that PWO scintillation mechanism does not suffer from radiation damage. An experiment at Protvino by shooting beam into the middle section of PWO crystals would confirm this conclusion.

- Two major procurements for PWO crystals and PMT have solid quotations from respected vendors. Their base cost should be modified to be consistent with the quotations. Corresponding contingency should be reduced from 40% to 30% level.

- Because of lacking detailed design, the contingency for the light monitoring system should be increased from 30% to 40% level.

- Crucial numbers, such as the total crystal volume and the channel counting, as well as the technical specifications for important procurement, such as PWO crystals, PMT and monitoring system, are not well documented.

- The ECAL team does not have sufficient US physicists on the project. All physicists related workloads are currently assigned to the Minnesota University and international collaborators.

Recommendations

1. Study the consequence of dark current increase caused by neutron activation and radiation induced phosphorescence in PWO crystals. Make corresponding design change of thermal regulation if necessary.

2. Investigate the light response uniformity of PWO crystals partially irradiated by hadrons. Reach a conclusion on radiation damage of the PWO scintillation mechanism.

3. Test all detector samples, including PMT from various vendors, in a BTeV equivalent radiation environment.

4. Put together crucial technical information in one document, e.g. the ECAL TDR.

5. Solicit additional US physicists.

1.5 Muon Detector

Findings

- Particpants include groups from Vanderbilt, Illinois and Puerto Rico totalling six faculty members. The BTeV muon detectors are composed of 1152 "planks" of 32 stainless steel drift tubes. These planks will be assembled into larger units called "quads", and three planes of 8 quads each will installed in the BTeV toroidal magnets. The front-end electronics for each plank uses the Penn ASDQ chip, latches, and a serial link to the DAQ. The chambers operate on a mixture of Argon and CO2 with an expected maximum occupancy of 2.5%, based on GEANT simulation of pbar-p collisions.

- 25 prototype planks have been constructed and operated successfully; a five plank cosmic ray telescope is operating at Vanderbilt. Some of these planks used the earlier ASD8b chip; planks using the the newer ASDQ chip performed better.

- A 1/5 scale model of the toroid regions has been constructed for studying installation of the detectors on the toroids and a preliminary concept for mounting them has been developed.

- No fully resource loaded schedule was shown, but the subproject management has completed M&S and labor estimates at various levels of detail. There is a subproject dictionary, with some entries well detailed and others lacking detail. Approximately two-thirds of the necessary labor is performed by physicists and students, who are funded through university base programs. Heavy utilization of this effort results in a project cost savings in the neighborhood of $1.7M.

Comments

- The detector design is well advanced, straightforward, technically adequate, robust and sound, and the project appears well managed.

- In most cases, the materials costs are plausible and the contingency appropriate. The largest exception would be the support and mounting of the chambers on the toroids, where the plan is still being developed. (For example, there is no level of detail below "Fabricate mechanical supports" at $210,000) Some of the costs (e.g. cables) are assigned at the project level. In at least one case, these costs seemed overoptimistic. The subproject management does not feel ownership of these items in the cost estimate.

- In many cases, cost estimates are beginning to move from top-down estimates to bottoms-up estimates driven by vendor quotes. This process is likely to increase the level of confidence and reduce the needed contingency.

- The labor cost estimate used a duty factor that the committee felt was aggressive, and because most of the labor was off project the contingency estimated - as a fraction of the funded part - was felt to be inadequate.

- Experience with other collider experiments is that a sizeable fraction of the occupancy is due to beam-induced backgrounds, not proton-antiproton collisions. The muon project plans to validate the MARS studies that led to this conclusion by mounting scintillator counters from the FOCUS experiment and making a measurement of the rates (admittedly in a somehwat different configuration than the final one). This plan has implications for the schedule of the C0 improvements, particularly AC power. If the occupancies are larger, the plan is to remove the innermost regions of the muon detector from the trigger and to rely solely on the pixel trigger in this region.

- Like all ASICs, the availability of the ASDQ chip becomes less certain over time. A backup plan exists that does not depend on using the chip that will ultimately be chosen by LHCb and other experiments on that timescale. Selecting the same chip as an LHC experiment may be a secondary option. The cost risk for this seems moderate, but it would be best to place the purchase order for these as soon as possible.

- The number of spare high voltage pods seems marginal.

Recommendations

1. Write a Technical Design Report describing the muon detector subsystem as it is currently envisioned.

2. Complete an integrated resource-loaded schedule.

3. Review and reassess the risks of the required labor saturating the physicist and student resources.

4. Review the number of spare high voltage channels needed.

5. Obtain vendor quotes on as many items as possible and reassess the contingency afterwards.

1.6 Straw Detector

BTeV WBS 1.6 describes the Forward Tracking Straw Detector, comprised of 26+k straws arranged in 7 stations with 3 layers in each of 3 views per station. The total channel count is 54k.

Findings

- Technical aspects of the construction of the active straw tracker components as presented are well understood with the exception of the carbon fiber manifold and the electronics attachments to the outer straw support channels. However, the first prototype module has yet to be tested in a test beam, and although there is also an impending round of tests of the usual parameters (aging, gas gain, etc.), to date these have been spotty and have not provided sufficient definitive information to yield a high confidence level in the operating parameters necessary to meet the BTeV stated goals.
- The electronics system required to operate the production Straw Tracker has no one presently working on it.

- Because of the lack of development in both the system electronics and in mechanical testing, the transition from prototype to production is presently poorly understood in terms of labor.

- Base costs for the mechanical constituents of the actual chambers are believable since they are extrapolated from recent purchases, information provided by vendor quotes or costs provided by ATLAS. Variations in the design plan for items such as Chamber Station 7 check out as little effect on cost or scheduling as they exist presently. Production tooling on the other hand does not exist, and while concepts may be envisioned from prototype construction, the actual details are vague and no one is currently working on design.

- Electronics costing requires a larger than allocated contingency because the base has been generated using generic costing techniques ("engineering judgment") without benefit of any specific engineering effort, and because considerable risk was associated with potentially losing the ability to procure desired components such as ASDQ or TDC chips within a reasonable time frame.

- Labor costing for assigned personnel appears to be arithmetically correct. Labor is biased heavily toward use of paid personnel for construction as well as a large amount of the necessary design work. Contingency is inappropriately low for a system that has not yet reached the pre-production phase and does not have concrete engineering support for mechanical or electronic aspects of the system.

- There exists a detailed schedule of mechanical and electronic assembly completion and testing dates. These are based on back loading from the points at which detector components must be completed in order to satisfy an installation criterion. Time frames and end points correlate with labor profile graphs shown. Since the engineering and production labor demands are still poorly understood, this is not presently a realistic resource loaded document.

- L2 management of the Straw Detector is currently also approximately one third of the full time active labor force. The plan for construction calls for multiple sites to contribute to the detector. The organization is currently lacking enough active collaborative effort to adequately oversee a project of this size.

Comments

- The Straw Detector has not been assessed in terms of alternate (396) running conditions that would presumably significantly change the occupancy rates in the straws. Laboratory management should indicate to BTeV whether this is an expected evaluation.

- BTeV L1 management needs to communicate clearly to L2 management where costs and responsibilities lie in the areas of transport of detectors from collaborating institutions and design of (potentially) shared space and support structures in C0.

- Documentation of material costs in particular in its present form is unwieldy and difficult to extract. If Open Plan does not construct a single basis for drill-downs with direct WBS dictionary links, consideration should be given to an alternate system or subset thereof before presenting information to any future review committees.

Recommendations

1. BTeV management will need to work with the Laboratory to insure timely allocation of engineering resources for the Straw Detector. Continued lack of support during the R&D phase will unacceptably slow the higher base/contingency/risk confidence levels required for future reviews.

2. The Straw Detector group should reevaluate their risk assessment to provide more definitive information on which portions can be mitigated through physical resolution and which must be either retained in or rolled over into contingency funding.

3. Straw Detector management needs to involve more collaborating institutions in substantive work on prototyping and pre-production planning so that advertised diverse site production is achievable both technically and on time.

4. Straw management should actively investigate collaboration with the Muon Detector group on electronic elements such as TDCs and ASDQ chips pursuant to commonality of design, procurement and/or construction of those elements.

5. The Straw Detector group must pursue an aggressive schedule to conclude the necessary studies of the operational parameters of the chambers such as aging so as to increase the confidence level in the ability of the detector to meet BTeV advertised physics goals as well as cost and schedule constraints.

Costs recommended reflect no change in base, but a contingency of 41% based on lack of finalized designs in some areas and the resultant labor uncertainties.

	Item	Project Estimate ($Millions)				Committee Estimate ($Millions)			
WBS		Base	Cont. %	Cont. $	Total	Base	Cont. %	Cont. $	Total
1.6	Forward Straw Tracker	5.93	30%	1.79	7.72	$5.93	41%	2.43	$8.36

1.7 Silicon Strip Detector

Findings

- The scope of this project is reasonable. While the scale is sizeable, the technical risk of not particularly high. The technology proposed for the silicon sensors and the hybrids is now fairly standard. The mechanical specifications look entirely feasible. The one area, which appears to have the most technical risk, is the readout chip. Although the fabrication process has been used for the prototype pixel chips, the silicon readout chip is still to be designed.

- Many of the principal personnel on the project (both physicists and engineers) have extensive expertise in designing and building similar systems.

- The project has about 1.5 years of R&D before the start of the production phase. At this point the design is still conceptual in several areas, in particular the hybrids, readout chain and external mounting.

- Since the project is in the R&D phase, but manpower needs were presented for the future production phase, there was no review of the overall level of staffing. It is noted that in several cases the same names are currently assigned to different parts of the project. We believe that additional manpower is needed.

- This review was not carried out in sufficient detail to confirm the baseline costs. Consideration was given to the contingency analysis. Schedule information was not available.

Comments

- In preparation for future reviews the documentation should be updated and augmented. The description in the technical documentation should be updated to reflect the current state of the technical design and base costs, assumed yields and spares should be explicitly called out. The subproject should provide a critical path analysis in a resource-loaded schedule, and a more detailed risk analysis.

- The cost estimate should be reexamined before the estimate is uploaded into Open Plan.
    - For the production chip, the spare count appears to have been omitted.
    - The spreadsheet describes the readout chip as two separate subprojects, it should be modified to reflect fabrication plans for a single chip.
    - A hybrid pitch adapter is likely to be needed to match detector and chip pitch. It is not yet included in the design.

- The rolled up contingency on the whole project is 31%. We believe this is too low for a project at this stage of conceptual design. Given the relatively standard technology in the project, we recommend contingency in the range 45%.

- Separate WBS elements are used to assign resources from different institutions to the same work task. This is done in such a way that task-based roll-ups of labor and cost resources are not always possible.

- Major purchases (including the production sensors and chips) include tasks for placing the orders and for phased deliveries in batches over many months. The costs are assigned to the delivery tasks, rather than the purchase tasks (i.e. as the order is partially costed rather than when the funds are obligated). This may make spending projections based on the existing schedule inaccurate.

- The list of 48 "major events" appears to be a reasonable set of milestones for monitoring progress in the project.

- Level 3 managers are not yet in place.

Recommendations

- Update the technical documentation and the WBS work plan to a current description of the project.
    - Review the quantities for spares, prototypes etc.
    - Review the contingency analysis and use a project-wide methodology.
    - Provide a critical path analysis and a more detailed risk analysis.

- Review the technical and scientific labor needed and available for the project.

1.8 Trigger Electronics and Software

Findings

- The Trigger Electronics and Software sub-project corresponds to a base cost of $10.06M (FY02) with an assigned average contingency of 42%. Following introductory presentations by the proponents, the reviewers and proponents met for six hours of frank and constructive interchanges. Although the depth of the review was limited by the lack of a resource loaded schedule, a fairly clear status of the project did emerge.

Comments

- The proponents are to be congratulated for several major advances that have reduced the technical risk of the trigger system. Notable among these advances are the use of C-code compilers for the generation of DSP Level-1 trigger code and the movement toward commercial switch hardware.

- The expected evolution of computing hardware and software technology (Moore's law) encourages schedule back-loading in order to achieve the best performance per dollar. This is always a delicate business and the absence of a resource loaded schedule precludes analysis of this risk.

- Despite the absence of a resource loaded schedule however, the proponents presented a detailed list of system components where the corresponding costs and contingency are ***plausible.***

- The cost-performance advantage of Moore's law was used in the costing of big-ticket components: FPGA, DSPs, and commodity farm processor nodes. These extrapolations were not unreasonable.

- Moore's law was not universally applied however to mid-ticket items, where it can apply as well. This could be a source of hidden contingency in the base cost.

- In order to the address the issue of fault tolerance in the complex trigger and DAQ systems some of the BTeV proponents have formed a collaboration with computer scientists outside of BTeV. This collaboration is referred to as "Real Time Embedded Systems" (RTES). The RTES collaboration has won a significant grant ($5M) from the NSF for this work, which nominally expires at the beginning of FY07.

Although the expected RTES techniques is the core solution for creating fault tolerance, the RTES collaboration is not strongly coupled to the BTeV project in any formal sense. There is not at present a clear list of deliverables from RTES, what the acceptance criteria would be, or how the tools would be maintained once the RTES project expires during the middle of the of the BTeV project. The BTeV proponents within RTES are aware of these issues, and are working to address them.

- The scope of the Level-2 and Level-3 processor farms are based on large extrapolations from prototype BTeV codes running on relatively slow processors. The proponents acknowledge the need for closer benchmarks, but there isn't a clear schedule of milestones in the ongoing R&D phase to address this.

- More generally, the first "significant event" (>$100K expenditure) in WBS-1.8 isn't until the 2nd quarter of FY05, more than two years from now. The WBS-1.8 is used now as cost-drive management tool which does not include important R&D events.

- Change-control documentation and culture is not well developed yet. This is understandable given the early phase of the project, but this culture and the corresponding paper trails will be critical to a successful baseline review.

- Many significant design issues are still discussed and validated in the small-group model. There are not well defined thresholds for change-control reporting, although there is clearly a sense among the proponents of keeping upper management in the loop for important decisions at present.

- The WBS-1.8 subproject is dominantly staffed with off-project manpower (physicists, postdocs, and students). Given that the assigned baseline cost is zero, any formal contingency is correspondingly small. Since these resources are off-project it is difficult to associate a sensible formal contingency, but it is clear that if half of these resources did not appear the project would be in big trouble. The BTeV management is aware of these potential risks, and have provided a historical analysis of the groups that constitute BTeV which supports the claim that these resources will be available.

Recommendations

1. Further scrub the base cost estimate to account for Moore's law advantage on mid-ticket items.

2. Within the context of the BTeV project, develop a set of deliverables, acceptance criteria, and maintenance provisions for the expected RTES tools.

3. Further develop the Change-Control culture so that Level-2 and Level-3 WBS managers are aware of performance, cost, and schedule variance reporting thresholds. Further, as the proponents move from the R&D to the project phase, the reporting of significant performance, cost, and schedule variances in clear, succinct, signed and dated documents is strongly encouraged.

1.9 Event Readout and Controls

Findings

- The Data Acquisition Electronics and Software sub-project corresponds to a base cost of $11.80M (FY02) with an assigned average contingency of 24%. Following introductory presentations by the proponents, the reviewers and proponents met for six hours of frank and constructive interchanges. Although the depth of the review was limited by the lack of a resource loaded schedule, a fairly clear status of the project did emerge.

Comments

- The costs as stated seem reasonable, they may be high – they include in-built contingency and costing of some components (e.g. the data buffer, data combiner an optical link) at 2002 availability rather than 2006+ when procurement occurs.

- The contingency seems to have been calculated through a formula which results in a very narrow distribution of contingency. Labor and material contingency were stated to be have tied together by this formula. They should be considered separately. The hidden contingency should be removed and included in the overall contingency for each WBS item. The CMS project should be consulted to include contingency appropriate to such a construction project.

- WBS items showing clearly the deliverables, schedule and dependency on the RTES project should be included. Additionally since RTES finishes in the middle of the WBS project plans should be included for acceptance of the deliverables and continued integration, testing and upgrades as needed.

- Despite their talent and efficiency, the individuals that are multiply listed in WBS Level-2 and Level-3 management roles can not viably continue in these positions as the project ramps up. There is also clearly the need for additional university groups and contributions in order to meet the deliverables of the data acquisition system.

- If the plan is to actually rely on use of the online farms for offline analysis the impact and requirements to support this should be included in the construction. Otherwise it will not happen.

- The DAQ database hardware costs can be reduced if the databases are hosted on commodity hardware (Linux) rather than Sun server machines. All indications from Run-2 developments are that this is not high risk on the schedule for BTeV.

Recommendations

1. The DAQ costs should be scrubbed to remove implicit contingencies from the base cost estimate and advance these to explicit contingencies as appropriate.

2. Within the context of the BTeV project, develop a set of deliverables, acceptance criteria, and maintenance provisions for the expected RTES tools.

3. Further develop the Change-Control culture so that Level-2 and Level-3 WBS managers are aware of performance, cost, and schedule variance reporting thresholds. Further, as the proponents move from the R&D to the project phase, the reporting of significant performance, cost, and schedule variances in clear, succinct, signed and dated documents is strongly encouraged.

1.10 Installation, Integration, etc.

Findings

- The WBS as presented totaled 4.3M$ base cost, with an estimated contingency of 31% for a total estimate of 5.6M$. Of this, 70% is Fermilab personnel.

- The WBS item includes the receipt of subassemblies from the other L2 tasks, and final installation of the detector in the C0 collision hall. Space for acceptance testing of subassemblies is foreseen, but the equipment to perform the tests is the responsibility of the other L2 subtasks. Shipment costs to FNAL of the off-site completed components is included in this WBS.

- This WBS includes the final finishing of the C0 hall for BTeV's needs. This is dependent on the completion in a timely manner of the proposed C0 AIP, and the detailed components included in the AIP. There was an AIP proposal generated, and a BD response to the proposal, but no further negotiations beyond that.

- This WBS includes a component for the completion of the documentation related to the overall system integration, testing, safety and commissioning. Sub-system documentation is the responsibility of the subsystems.

- The boundary as understood by BTeV for the interface with the Beams Division is that the shielding wall at the Q4 provides the interface between BD and BTeV, except for the installation of the compensation dipole not in the toroid, the beam vacuum and emptying of C0 hall. These tasks are not included in the installation sequence as presented.

- A plausible 1st order installation sequence was created by BTeV, in large part based on information generated by the collaboration at an installation workshop in Spring 2002. The plan includes installation of all the large components in the collision hall during major accesses (requiring the shield wall to be moved), with smaller components transported through the labyrinth hallway on an as needed and as available basis. The plan is consistent with the C0 mechanical limitations (hook availability, etc) and with the boundary condition of minimizing Tevatron interruptions. It was stated the major components could be moved in during a single 3 month shutdown (after WBS 1.1 is complete), or several (3-4) shorter duration shutdowns.

- A random drill down on the WBS item showed it to be reasonably complete. The WBS dictionary was available.

- The component estimates (1.10.3) included in the WBS were developed by the other L2 sub tasks, and transferred to this WBS to form a sensible means to organize the installation activity. The contingency on these items was estimated by the other L2 subtask managers.

- There is not an integrated, resource loaded schedule for this WBS. Need dates for the other L2 deliverables are not integrated as yet.

- It is recognized that project management will need to negotiate with FNAL for on-site storage space as final assembly nears.

- The WBS rollup spreadsheet has activities with "0" durations that are not milestones. There are M&S costs assigned to these activities also.

Comments

- In many ways, the building blocks for this task appear available and reasonable. They need to be assembled in a manner consistent with the rest of the project.

- Use of consistent numbers in the WBS and in the presentations, and breakout presentations would be very helpful in making the system more transparent to the next reviewers.

- The reviewer would add 2.5M$ to the contingency of this subtask, the difference between the original 5M$ estimate submitted to the lab in 1999 and the response which totalled approximately 2.5M$. If the AIP is not completed, BTeV will end up completing C0 on project funds. This change gives revised costs of 4.3M$ base, 89% contingency and a total cost of 8.1M$.

Recommendations

1. An integrated, resource loaded schedule must be completed for this task.

2. The WBS dictionary and roll-up should be scrubbed and owned by L2 management.

3. Definition of responsibility for interface documents internal and external to BTeV should be made clear.

4. A detailed milestone list needs to be generated and transmitted throughout the project.

5. The C0 AIP must be defined and completed.

6. Mining data from other projects (KteV) for comparable top level installation costs would provide a useful check of the estimate.

7. Complete a formal agreement with Beams Division on the work to be done at C0 by BD personnel.

1.11 Project Management

Findings

Include an assessment of technical, cost, schedule, and management

- Interim Project Management team has given considerable thought as to how they will manage the project, and they seem generally to have good plans.

- However, there is no written document, and many of the project management methods sketched still lack specificity.

- Technical change control system is operating at a rudimentary level
  requirements documents exist for each L2 system under change control by PMs
  - Technical Board = Change Control Board exists (de facto) and is in operation
  - system exercised for change of low-p RICH system from aerogel to liquid

- The rest of the change control system has yet to be constructed
  - Change control authorities and thresholds not defined for technical, cost or schedule

- System of internal reviews is planned
  - Annual review of whole project
  - rolling set of annual reviews of each L2 system

- Plan to do regular site visits of all collaborating institutions

- Technical Board exists
  - Serves as change control board
  - Serves as forum for regular, “informal” project technical discussion, prior to formal decisions being required
  - Serves as forum for discussion of resource management issues . . . serves for the moment to fill the role of “Institutional Board,”

- No institutional Board for the moment
  - Roll currently filled by Technical Board
  - May be brought into existence if number of institutions grows, or if the level of foreign contribution grows.

- Indirect costs have only partially been included in the Project cost estimate
  - Estimate that cost will grow by about $10M once they are all included.

- System integration, all the activities that preceed the physical integration of the detector in the collision hall, is deemed to be a project office function
  - The responsibility for dealing with interfaces between different systems needs to be well defined
  - System for dealing with external interfaces – principally to the accelerator – doesn’t exist yet.

- L2 managers are intended to have full authority over their systems, including putting work where it can best be done. However, they must convince a university that they should want to do it.
  - Worry about difficulty if FNAL wants to hold onto the work.
  - PMs believe that the L2M's know their authority

- Integrated project management software system is being implemented
  - Description of what it can do is impressive
  - Intend to give each L2M full access to his/her sub-project
  - Includes integrated system for contolling who is authorized to change what
  - Expect to have fully resource loaded schedule for the whole project by the end of the year
  - Expect to track all "on-project" work, independent of funding source (DOE, NSF, INFN) in an integrated way . . . details to follow.

- A substantial fraction of the total Project manpower is not costed – physicist, post-docs, graduate students.
  - Ratio of collaborators, assumed to be integrated over 5 years, to estimated number of FTE-years of physicists, yields required duty factor of 0.3, which is believed to be conservative.
  - No dollar contingency is reserved for risk of physicist labor not appearing as planned.

- Project office has 13 positions identified (including 2 co-PMs)
  - 7 positions have interim personnel assigned
  - 1 has a temporarily assigned person, and 2 have people "only on a consulting basis"
  - 3 positions are TBD
  - Personnel cost estimate adds to 45 (36) FTE-years total (non-physicist) => 70(65)% duty factor assuming 5 year duration.
  - Assert in viewgraphs that PO personnel are occupied 75% time on PM, and 25% contingency brings them to full-time

- Project depends for its success on a number of related projects:
  - C0 AIP
  - Design and construction of low-beta insertion
  - Software and computing for data analysis
  - RTES

- There is considerable inconsistency among L2 systems in preparation for this review
  - Cost and contingency estimating methodology
  - Method of presentation

Comments

- Risk of physicists not being available as planned include not only the "duty factor" being lower than estimated, but inability to move physicsts from where they are to where they may be needed, or substantial underestimate of the physicist effort required. Thirty percent duty factor on project may not be such a large number, when considering the effort required for off-line computing, which is not considered part of the construction project.

Recomendations

1. Write a Project Management Plan, that includes all of the elements discussed today, with details filled in.

2. Define change control authorities and thresholds for technical specifications (functional, interface,…), and for cost and schedule changes.

3. Consider supplementing "calendar-driven" system of internal reviews with "event-driven" reviews.

4. Include all indirect costs in cost estimate

5. Clarify responsibilities for system integration and for control of interfaces between L2 systems and between BTeV and external systems (Tevatron, C0 AIP).

6. Clarify the responsibilities and authorities of L2 managers with regard to control of resources and work assignments.

7. BTeV and Fermilab need jointly to develop a formal system for controlling interfaces between BTeV and the accelerator. Some early (even if short) meetings between BTeV and the Beams Division will be needed to coordinate aspects of the BTeV design which clearly affect accelerator performance.

8. Establish methods for tracking of work and associated costs for tasks funded from non-DOE sources (i.e. those not passed through Fermilab), such as NSF or INFN.

9. Evaluate the risks associated with "free" physicist labor on each subproject, to establish monetary contingency amount to cover this risk.

10. All Project Office personnel who are intended to work full-time on the project should be included in the base cost estimate at 100% time. (Contingency should cover possibility that more personnel may be required, or that per-person cost is higher than estimated.)

11. Apply common methodology for estimating costs and contingency

1.12 Summary Comments on Review of BTeVCost Estimate

Findings

- Specific comments on the cost estimates for the various WBS Level 2 elements of the BTeV project are included in the text on each Level 2 element. This section attempts to summarize the committee's overall view of the estimate.

- The BTeV team has done an admirable job of developing a good basis for the estimate at this early stage of the project. The estimate is based on the preparation of requirements and specifications; significant R&D results; some preliminary system design; and in several cases quotes for large cost items. However, a significant contributor to cost uncertainty is the lack of an integrated resource loaded schedule. Currently, each Level 2 project is allowed to develop their schedule without funding constraints.

Comments

The table below depicts the committee assessment of the cost estimate at this point in time.

	Items	t Estimate ($Millions)				Committee Estimate ($Millions)				
WBS		Base	Cont. %	Cont. $	Total	Base	Cont. %	Cont. $	Total	
1.1	Vertex, Toroidal Magnet, Beam Pipe	1.34	40%	0.54	1.88	$1.34	40%	$0.54	$1.88	
1.2	Pixel Detector	11.8	45%	5.28	17.08	$11.80	45%	$5.28	$17.08	
1.3	RICH Detector	10.03	28%	2.79	12.82	$10.03	35%	$3.51	$13.54	[1]
1.4	EM Calorimeter	10.69	32%	3.47	14.16	$11.30	28%	$3.21	$14.51	[2]
1.5	Muon Detector	3.43	40%	1.36	4.79	$3.61	50%	$1.81	$5.42	[3]
1.6	Forward Straw Tracker	5.93	30%	1.79	7.72	$5.93	41%	$2.43	$8.36	[4]
1.7	Forward Silicon Microstrip Tracker	4.65	28%	1.29	5.94	$4.90	45%	$2.21	$7.11	[5]
1.8	Trigger Electronics and Software	9.98	42%	4.24	14.22	$9.98	42%	$4.24	$14.22	
1.9	Event Readout and Controls	11.82	24%	2.86	14.68	$11.82	24%	$2.86	$14.68	
1.10	System Installation, Integration, etc	4.26	31%	1.31	5.57	$4.26	89%	$3.81	$8.07	[6]
1.11	Project Management	4.39	25%	1.10	5.49	$6.46	15%	$0.97	$7.43	[7]
	Indirect Cost that was not included					$8.14	25%	$2.04	$10.18	[8]
	Total	$78.32	33%	26.03	$104.35	$89.57	37%	$32.89	$122.46	

Notes:

[1] WBS 1.3 - 50% of the sub-project cost is to be found in the photon-detectors (either HPDs or MAPMTs). Both options are backed up with quotations. Contingency assigned here is taken from variation in quote pricing for the MAPMTs. Most other big-ticket items are backed up with vendor quotations in the cost book. This includes 5000 PMTs (3-4 possible vendors), readout electronics, mirror arrays and power supplies. Other bases for estimate are tied to previous experience from the proponents with the CLEO III RICH, a proximity focused detector. The total project contingency has been increased to 35% to account for uncertainties in fluctuation of the dollar relative to foreign currencies since the HPDs and MAPMTs are from foreign suppliers.

[2] WBS 1.4 covers the PWO crystal electromagnetic calorimeter (ECAL) subsystem. The total base cost is estimated to be 10.6 M$, including 8.5 M$ of material and 2.2 M$ of labor. The overall total cost is 14.2 M$ with an overall contingency of 32%. With solid quotations from respected vendors, the reviewer modified the base cost of PWO crystals and PMT correspondingly and reduced the contingency from 40% to 30%. Lacking detailed design, the reviewer increased the contingency for LED monitoring system from 30% to 40%. The reviewer's estimation is overall total cost of 14.5 M$ with base cost of 11.3 M$ and contingency of 28.4%.

[3] WBS 1.5 - The base was changed to $3.61M. Half of that is from assuming a smaller duty factor for the labor, and half is from increasing the cost of the support structure, which is at a conceptual stage and looks unrealistically low.

The contingency was changed to 50% or 1.80M. The M&S contingency is about the same (43% vs. 42%) but holding $200k of labor contingency on $2.5M of labor ($1.7M of which is off-project) seems inadequate.

[4] WBS 1.6 -
1.6.1 Labor Increase contingency to 45% - Production flow not yet defined. 1.6.1 Materials Increase contingency on 1.6.1.5 to 50% - Tooling & fixturing not designed; Decrease contingency on 1.6.1.4.1 to 10% - Reliable Quote; Increase contingency 1.6.1.4.1 by 20% (net back to 30%) Foreign vendor – uncertainty in currency fluctuations; Decrease contingency on 1.6.1.4.3 to 10% Reliable Quote; Increase contingency 1.6.1.4.3 by 20% (net back to 30%) Foreign vendor – uncertainty in currency fluctuations. (Total contingency for 1.6.1 averages to 40%)
1.6.2 Labor Increase contingency to 50% - Lack of development of system. 1.6.2 Material Increase contingency on 1.6.2.3 & 1.6.2.4 to 40% - Lack of development of system Uncertainty of acquisition timing; Increase contingency on 1.6.2.7 to 50% Foreign vendor – uncertainty in currency fluctuations. (Total contingency for 1.6.2 averages to 42%)
1.6.3 Labor Increase contingency to 45% - Uncertainties in difficulty of layout and development. 1.6.3 Material Contingency remains @30% - Generic requirements understood to that level. (Total contingency for 1.6.3 averages to 39%)
1.6.4 Labor Increase contingency to 45% - Uncertainties in testing time & difficulty in reaching consensus on integration issues. 1.6.4 Materials Contingency remains @30% - Testing equipment required understood to that level Integration materials small portion of cost. (Total contingency for 1.6.4 averages to 40 %)
1.6.5 Labor Contingency increased to 50% - Uncertainties in off/on project labor. 1.6.5 Materials Contingency remains @30% - Generic requirements understood to that level (Total contingency for 1.6.5 averages to 44%)
Overall contingency averages to 41% on unchanged BTeV base

[5] WBS 1.7 - Baseline costs were modified for three items which were examined in the BTeV EXCEL spreadsheet. 1) Spares were not included in the readout chip production quantities ($53k). 2) Labor costs for chip development are underestimated (FNAL labor is not yet included $100k). 3) Pitch adapter/fanouts were not included in the hybrid cost estimate ($100k). A detector at this level of conceptual design should have a contingency of ~50%. We lowered this to 45% based on the fact that the detector is not technically challenging.

[6] WBS 1.10 - 2.5M$ was added to the contingency of this subtask, which is the difference between the original 5M$ AIP estimate submitted to the lab in 1999 and the response which totaled approximately 2.5M$. If the AIP is not completed, BTeV will end up completing C0 on project funds. This change gives revised costs of 4.3M$ base, 89% contingency and a total cost of 8.1M$.

[7] WBS 1.11 - Add Base+Contingency from Project estimate, increase per-person take-home pay $85k->100k

[8] Increase base cost by 10% to cover indirect costs that have not been included.

- All cost numbers presented in this review were in FY02$. Frequently project considerations require the estimate in "as spent" or "actual year" dollars. An estimate of the escalation factor to get to "as spent" dollars is to take the average escalation rate (say 3%/year; 2% on equipment, and 4% on labor) to the mid-point of the project 2006 and escalate to there. That would be an approximate 12% increase to the FY02$ amount.

Recommendations

1. The committee estimate should be incorporated in thinking for BTeV and Fermilab going forth with a cost range in seeking a CD-0/1 for the BTeV project. The reason we're suggesting a CD-0/1 is that to get a CD-0 a mission need external independent review must take place which for HEP seems to be P5 or something like it. Such a review will likely require a sound cost range as input.

1.13 Summary Comments on Review of BTeV Schedule

Findings

- It is anticipated that the project will begin October 1, 2004.

- Furthermore it is anticipated that project completion will be early in fiscal year 2008.

- A critical interim milestone is “readiness to install large components,” currently planned for April 2006.

- BTeV is in the process of uploading their "EXCEL" project schedules into Open Plan

- R&D results were presented in the overview talks and breakout sessions and near term planned R&D was described.

Comments

- No easily understood resource loaded schedule exists. This situation will be rectified with the completion of the Open Plan uploads and optimization process.

- R&D is not incorporated in the formal schedule plans.

Recommendations

1. BTeV is encouraged to complete the Open Plan loading and initial optimization (including incorporation of presently assumed funding constraints) process as soon as possible. The BTeV team has a goal of the end of the calendar year for completing this task.

2. BTeV should consider incorporating R&D into the overall Open Plan schedules for the project to show how the project activities are dependent upon R&D outcomes and therefore the schedule requirements for providing the R&E results.

Director's Status Review
of
BTeV

CHARGE TO THE COMMITTEE

Charge for
BTeV Director's Status Review

A substantial Collaboration of physicists interested in performing B-physics at the Tevatron in the post CDF/D0 era has formed. This Collaboration has proposed a BTeV experiment be mounted at the Tevatron C0 interaction point. R&D in preparation for such an experiment has been underway for a few years and the proposal has gained Stage 1 approval by the Director following such a recommendation from the Physics Advisory Committee. As part of it's oversight role the Fermilab Directorate would like to hold a Status Review of the BTeV activities.

This status review will look at the typical aspects covered in most project reviews, but at the outset it is recognized that BTeV is only in the initial formative stages of becoming a project. Thus, the review will look at the technical, cost, schedule, and management aspects of BTeV to the extent they are developed.

In anticipation of a P5, or similar, review of a proposed project by HEPAP and/or the DOE, **the focal point of this status review will be assessing the level of confidence that cost estimate deserves at this stage of development**. The committee should assess progress in the technical, schedule, and management areas as well, specifically in the context of support for the cost estimate. The committee may also comment upon the types of things that will need to be further developed prior to a Lehman Baseline Review.

Director's Status Review
of
BTeV

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Director's Status Review
of
BTeV

REVIEW AGENDA

Monday, September 30, 2002

8:00 AM – 8:45 AM	Executive Session (1 West)
9:00 AM – 9:15 AM	Introduction
9:15 AM – 10:15 AM	Project Overview
10:15 AM – 10:30 AM	BREAK
10:30 AM – 11:30 AM	Trigger and DAQ
11:30 AM – 12:30 PM	LUNCH on 2nd Floor Crossover
12:30 PM – 1:30 PM	Tracking Systems (Held in Curia II)
1:30 PM – 3:00 PM	Particle Identification Systems
3:30 PM – 3:45 PM	BREAK
3:45 PM – 4:15 PM	Mechanical and Integration (Held in 1 West)
4:15 PM – 5:30 PM	Breakouts (See Breakout Chart)
5:30 PM – 6:30 PM	Executive Session (Held in Comitium)
6:30 PM – 7:00 PM	Coctail Hour
7:00 PM	Dinner at Chez Leon

Tuesday, October 1, 2002

8:00 AM – 12:00 Noon	Technical/Cost/Schedule Breakout Sessions (See Breakout Chart)
11:10 AM – 1:20 AM	Firedrill
12:00 Noon – 1:00 PM	LUNCH
1:00 PM – 2:30 PM	Continue Breakout Sessions
2:30 PM – 3:00 PM	BREAK
3:00 PM – 4:30 PM	Executive Session
4:30 PM – 6:00 PM	Begin Writing Report

Wednesday, October 2, 2002

8:00 AM – 11:00 AM	Continue Writing Report
10:00 AM – 12:30 PM	Dry Run of Closeout
11:45 AM	Grab Working LUNCH (continue Dry Run of Closeout)
12:30 PM – 1:30 PM	Upload Report Sections
2:30 PM – 3:30 PM	Closeout with BTeV and Fermilab Management